A cost effective, community based heart health promotion project in England: prospective comparative study

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Abstract

Objective: To determine whether a community based coronary heart disease health promotion project, undertaken over four years, was associated with changes in the prevalence in adults of lifestyle risk factors known to affect the development of coronary heart disease, and to estimate whether such an approach was cost effective.

Design: Prospective, comparative study of the effects of a health promotion intervention on coronary heart disease lifestyle risk factors, assessed by postal questionnaire sent to a randomly chosen sample, both at baseline and after four years.

Subjects: Intervention and control populations of adults aged 18-64 in Rotherham, both from areas with a high incidence of coronary heart disease and similar socioeconomic composition.

Main outcome measures: Changes in prevalence of lifestyle risk factors between the control and intervention communities from 1991 to 1995. The effect of the intervention on certain lifestyle behaviours was evaluated using multiple logistic regression to model the proportion with a particular behaviour in the study communities as a function of age (18-40 or 41-64 years), sex, the year of observation (1991 or 1995), and area (intervention or control).

Results: 6.9% fewer people smoked and 8.7% more drank low fat milk in the intervention area, but no other statistically significant changes between the areas were detected. The estimated cost per life year gained was £31.

Conclusions: It is possible to have a cost effective impact on coronary heart disease lifestyle risk factors in a population of adults over four years using only modest resources.

Introduction

Once established, coronary heart disease is impossible to cure, so a successful prevention strategy is the only way to reduce the long term burden. Lifestyle risk factors are associated with the development of and mortality from coronary heart disease.[1-7] Prevention projects that focus on lifestyle risk factor modification have been shown to reduce the development of coronary heart disease and mortality from it.[8-11]

In 1991 we began a controlled, before and after study of the effects of a health promotion programme (Action Heart) using a population approach lasting four years to determine whether such an intervention was cost effective in a typical, non-teaching, English health district. The findings for children have been reported elsewhere.[12] We now report our findings in adults. Our objective was to evaluate the potential for producing lifestyle changes that affect the development of coronary heart disease.

Methods

The study design was a prospective, comparative study of the effects of the Action Heart health promotion intervention among two populations of adults. The intervention area, the adjacent communities of Swinton and Wath, was chosen for its high incidence of coronary heart disease. The control area (Maltby) had a similar record for coronary heart disease and socioeconomic composition (table 1). It was also sufficiently far from the intervention area to minimise contamination.

Action Heart used several recognised health promotion approaches[13] (see appendix 2 (http://www.bmj.com)).

We assessed risk factor status using a self completed questionnaire covering personal details, sources of health information, personal history of blood pressure and cholesterol measurement, family health history, diet, exercise, and smoking. Questions were chosen on the basis that they had previously been used in postal questionnaires; were free from bias and ambiguity; were appropriate for the Action Heart survey; had content validity; and were the subject of previous research.[14 15] The questions relating to smoking and milk consumption are shown in Appendix 1 (http://www.bmj.com).

At the time of sample size determination we did not know whether our study would receive funding

Table 1 Standardised mortality ratios (SMR) from coronary heart disease in 1981-8 (95% confidence intervals) and rankings and values of electoral wards for deprivation indicators for control (Maltby) and intervention (Swinton and Wath) areas in 1990

Under 65 SMR1981-1988	Maltby	Swinton	Wath
Men	138 (129 to 147)	131 (123 to 139)	136 (128 to 144)
Women	190 (184 to 196)	176 (171 to 181)	170 (165 to 175)
Deprivation rankings* (and values):			
Jarman score	14 (3.5)	12 (1.5)	9 (–1.2)
Department of the Environment index	13 (0)	11 (-0.6)	8 (–1.0)
Rotherham Metropolitan Borough Council index	16 (28)	9 (12.0)	13 (23.0)
Unemployment rate	12 (11.8)	10 (11.3)	7 (10.4)

*Among the 22 electoral wards in Rotherham.

and whether we could do a follow up survey. However, we wanted to have good estimates of risk factor prevalence in the populations, while recognising that the sample size would be limited by the financial resources available. In undertaking sample size calculations based on confidence interval estimates, we assumed that (*a*) levels of risk factors in both areas were the same at baseline; (*b*) reductions in the level of cigarette smoking were the primary end point; (*c*) the prevalence of smoking in both areas was 34% at baseline; and (*d*) reductions over three years in the prevalence of cigarette smoking attributable to Action Heart which would be considered of public health importance were of the order of 2%.

To estimate smoking prevalence within 1% of the true value with 95% probability required an achieved sample size of 1509 from each area. To attain this, we mailed 1887 questionnaires to each area assuming an 80% response rate. We assumed that any background changes in smoking prevalence would be the same in both areas. The General Household Survey estimated that smoking prevalence was reducing by 1% per year in the age groups chosen.[16]

Questionnaires were mailed to a randomly chosen sample of named adults from the Rotherham Family Health Services Authority population age-sex register. The baseline survey was carried out in July 1991. The post-intervention survey was carried out in June 1995 using a similar approach but sent to a different random sample. (Following the cohort of individuals identified in the baseline survey would have increased statistical power but cost too much.)

The proportions of questionnaires mailed to the subgroups of men or women aged 18-40 or 41-64 were the same in both intervention and control areas for the 1991 survey. In the 1995 survey the proportions of mailed questionnaires were adjusted to try to achieve equal numbers of respondents in each of the four age-sex subgroups based on the 1991 survey response rates. This ensured best estimates of risk factor prevalences in the subgroups. However, the response proportions for age-sex subgroups were not the same as those in the underlying population for both areas as measured by the 1991 and 1995 estimates from the Office of Population Censuses and Surveys modified by local authority estimates. To adjust for overcoverage and undercoverage in the four age-sex subgroups due to this sampling frame error[17] we weighted the responses so that they were directly proportional to the corresponding subgroups in the OPCS ward populations. Weighted data were used only in the univariate analysis. Age and gender terms were used in all of the logistic regression models.

Coding—Decision rules for coding to define outcomes were made by the senior registrar in public health and a research officer.

Analysis—A univariate analysis was used to compare the prevalence of lifestyle risk factors between the control and intervention communities from 1991 to 1995. The effect of the intervention on lifestyle behaviours was evaluated using multiple logistic regression to model the proportion with a particular behaviour in the study communities as a function of age-group (18-40 or 41-64 years), sex, the year of observation (1991 or 1995), and area (intervention or control). After modelling the prevalence of the lifestyle behaviours for sex, area, and age group separately, the effect of the intervention was measured by comparing the change in the proportion showing that behaviour between 1991 (preintervention) and 1995 (post-intervention) in the intervention area with the change between 1991 and 1995 in the control area, the test being based on the interaction between year and area. We also examined whether the effect of the intervention differed between the age groups and sexes.

Economics—A cost-effectiveness analysis was undertaken from the perspective of the purchaser, Rotherham Health Authority, to determine the technical efficiency of the Action Heart programme compared with traditional investment in disease management and other health promotion approaches to coronary heart disease. Outcomes were measured in units of life years gained, estimated from reported changes in smoking status using an epidemiological model. Cost data were collected in two ways. Firstly, data were extracted from financial records kept during the trial which listed actual expenditure over the four year study from a designated budget. Secondly, estimates of non-project staff costs and overheads incurred by the project were measured using diaries and timesheets kept by staff since the launch of Action Heart. Whitley Council pay scale rates were used to estimate the value of staff time. Costs relating to the research aspects of the trial were excluded from this analysis. Costs were discounted at the government recommended rate of 6%.[18]

Results

Response rates of 82-86% were achieved for both baseline and post-intervention surveys (in 1995, when responses were analysed by subgroup, these ranged from 74% in men aged 18-40 in the control area to 93% in women aged 41-46 in the intervention area).

Univariate analysis

Smoking decreased in the intervention area between 1991 and 1995 but increased in the control area: the difference in smoking prevalence between the two areas increased from 4.2% in 1991 to 9.2% in 1995. The only other marked difference in risk factor prevalence between the areas was for low fat milk consumption, which increased by 7.6% (table 2).

Multiple logistic regression

The odds ratio for active smoking in the intervention area in 1995 compared with 1991 was 0.83 (95% confidence interval 0.71 to 0.97); in the control area it was 1.1 (0.95 to 1.29). The difference in these odds ratios is statistically significant ($\chi^2 = 6.4$, $P = 0.01$), providing statistical evidence of an effect for the intervention over all age-sex groups. There was no evidence that the intervention effect differed between the age groups ($\chi^2 = 0.33$, $P > 0.5$), but weak evidence that it differed for men and women between 1995 and 1991($\chi^2 = 2.6$, $P = 0.11$), which suggests a relative increase in smoking rates for women in the control area but little difference for men.

The odds ratio for drinking low fat milk in 1995 compared to 1991 in the intervention area was 2.58 (2.22 to 3.01) and in the control area 1.81 (1.55 to 2.11; $\chi^2 = 10.3$, $P < 0.001$). There was no evidence that the intervention effect differed between the age groups

Table 2 Risk factor comparisons between Action Heart control and intervention areas for 1991 and 1995. Values are percentages (and numbers)

Risk factor and area	1991	1995	Estimated effect %* (95% CI)
Active smoking:			
Intervention	32.2 (495)	28.8 (417)	–24.5 (–39.4 to –6.1)
Control	36.4 (511)	38.0 (578)	
Passive smoking:			
Intervention	41.8 (434)	33.8 (344)	–7.6 (–28.8 to 19.8)
Control	49.2 (450)	42.4 (397)	
Wholemeal bread:			
Intervention	23.6 (368)	25.0 (355)	9.2 (–11.7 to 35.1)
Control	17.2 (247)	18.9 (283)	
Low fat spreads:			
Intervention	61.8 (963)	66.0 (946)	–1.1 (–19.4 to 21.5)
Control	58.0 (831)	62.5 (937)	
Low fat milk:			
Intervention	48.2 (752)	71.0 (1038)	42.5 (14.8 to 77.0)
Control	53.6 (767)	68.8 (1055)	
Exercise:			
Intervention	53.7 (836)	52.8 (781)	2.7 (–17.2 to 27.3)
Control	52.7 (754)	50.6 (790)	
Obesity or overweight:			
Intervention	45.4 (689)	51.4 (752)	9.7 (–15.1 to 41.6)
Control	50.5 (697)	57.9 (887)	
Blood pressure:			
Intervention	81.8 (1268)	86.4 (1274)	28.8 (–4.6 to 73.9)
Control	84.4 (1204)	85.3 (1317)	
Cholesterol:			
Intervention	14.7 (228)	29.6 (436)	–2.4 (–25.1 to 27.3)
Control	13.1 (186)	30.2 (467)	

*Estimated adjusted percentage change in the odds of the risk factor in the intervention group compared with the control group over the study period.

($\chi^2 = 0.11$, $P > 0.5$), but there was weak evidence that it differed between sexes ($\chi^2 = 3.12$, $P < 0.05$). There was an approximate doubling in the odds of using low fat milk between 1991 and 1995 in men in both the intervention (odds ratio = 2.30) and control (1.95) areas; the effect was slightly less for women in the control area (1.68), while for women in the intervention area the odds trebled (2.93).

There were no statistically significant odds ratio differences for the other risk factors. An alternative analysis was also done using the baseline values as a covariate in a covariance style regression model . The results were very similar to those presented above.

The costs of the Action Heart community project incurred by Rotherham Priority Health Trust are shown in table 3. Overall, 57% of the £108 774 spent went on Action Heart project staff, 35% on other NHS workers, and 8% on schools expenditure.

Discussion

The primary aim of Action Heart was to produce lifestyle changes that would influence the development of coronary heart disease using a community based prevention approach. The results show that over four years there have been important reductions in smoking—our primary end point—in the intervention area and also significant increases in consumption of lower fat milk. The quasi-experimental study design we used to evaluate Action Heart[19] enabled us to control for confounding factors as far as possible.

Routine data provided no evidence on socioeconomic factors in these areas that could account for the observed lifestyle changes. For example, unemployment rates were similar in both areas in 1991 and 1995, and both areas had experienced similar declines, from 11.1% to 9.6% in the intervention area and from 11.4% to 10.2% in the control area. We have not been able to identify any other factors that might account for such lifestyle changes. The most likely explanation is that they were associated with the intervention.

A computer model based on the American Cancer Society's 50 state study on cancer prevention[20] predicts that the median gain in life expectancy for the age group 18-64 years will be 3.5 years (R Anderson, Department of Health). Of the 14 500 people in the intervention area, we estimate that 6.9% (1.3 to 12.25) more of them would be active smokers had Action Heart not taken place, resulting in an estimated health gain of 3581 life years in the intervention area. The gain may actually be greater since it would probably have accrued to the elderly as well.

The cost of the project was about £110 000. The greatest area of uncertainty in this figure relates to other NHS costs, which contributed about £40 000 (table 3). If we have underestimated these costs by 100% Action Heart would have cost £150 000. This potential underestimate was used as the basis for a sensitivity analysis. If the project cost was accurate the undiscounted cost per life year gained associated with Action Heart was £31; if the cost was in fact £150 000, the undiscounted cost would increase to £42. With a discount rate of 6% the costs would be £117 and £160 respectively. In either case, Action Heart represents good value when compared with other healthcare interventions for a variety of diseases,[21] health checks such as the Oxcheck and British family heart studies,[22-24] primary and secondary coronary heart disease prevention using statin therapies,[25 26] and another community based coronary heart disease prevention programme.[27]

We measured the benefits from quitting smoking in natural units of life years gained which would be realised at the end of an individual's life. Discounting the benefits gives more weight to the life years gained by elderly people who stop smoking because they reap the benefits sooner. We have not measured the other health benefits to be gained from quitting smoking which would be realised at an early age. We also have not estimated the

Table 3 Resource consumption in the community project

Resources used	Units used	Cost per unit (£ per hour)	Total cost (£)
Action Heart Project office			
Community project officer	1 worker	11.19	25 322
Community project worker	1 worker	5.38	12 439
Consumables	N/A	N/A	22 653
Other costs eg telephones	N/A	N/A	1300
Total			**61 714**
Other NHS staff			
Meetings	889 hours	10.86	9 654
Events:			
Preparing	1663 hours	10.86	18 060
Executing	983 hours	10.86	10 665
Total			**38 379**
Schools expenditure			**8681**
Grand total			**108 774**

N/A = unable to express in terms of cost per units.

health service costs avoided by the likely reduction in episodes of treatment for smoking related diseases. We have therefore probably underestimated the health and resource benefits likely to accrue from Action Heart.

A longer follow up is required to assess fully the long term effectiveness and overall cost effectiveness of Action Heart. We cannot identify which aspects of the project contributed to the change in smoking prevalence or why most other risk factors showed no significant changes in prevalence. We also note an alarming increase in the prevalence of overweight and obese adults in both intervention and control areas.

We believe that the change in low fat milk consumption between control and intervention areas could be attributed largely to a "Wake up to semiskimmed milk" promotion which took place in spring 1994 and summer 1995, financed by Action Heart and two local dairies. Leaflets promoting low fat milk were delivered to 7000 households in 1994 and 4000 in 1995. The difference was relatively small compared with the background trend (table 3). We estimated that if half the population who drank full milk changed to semiskimmed milk, and had energy and fat daily intakes of 2300 kcal and 100 g, they would lose about 5 g of fat from their daily diet. Since half of the population is drinking low fat milk already, this would reduce the percentage energy from fat on average from 40% to 39%. But we know this percentage is reducing only slightly because of fat substitution.[28] The exact impact on the Health of the Nation target for the percentage energy from fat is therefore difficult to quantify.

Evidence from heart attack registers suggests that much of the fall in mortality from coronary heart disease in most developed countries is due to changes in risk factors rather than to advances in medical care.[29 30] Some form of heart health promotion programme is taking place in every health district in England and in similar populations in many other countries worldwide. The resources allocated to each of these programmes are unlikely to have reached even the modest allocation to Action Heart, and few are likely to have been adequately evaluated. We believe that there are international implications from our study for investment policy in local heart health promotion programmes given the overall paucity of investment in this area.

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Conflict of interest: None.

Key messages

- Little is known about the cost effectiveness of focused, heart disease health promotion projects in reducing cardiovascular risk factors over a short period in small populations of adults
- Research was undertaken to estimate the impact of a heart disease health promotion project—Action Heart—and relate the cost to estimates of health gain
- Major differences were observed in changes in prevalence of active smoking and consumption of low fat milk between the intervention and control areas over four years
- The estimated cost per life year gained was £31
- Further research is required to ascertain whether the changes in risk factors will be sustained after the end of Action Heart

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